

## **PAPER FEEDING MECHANISM**

### **BACKGROUND OF THE INVENTION**

#### **1. Field of the invention**

5      The invention relates to a paper feeding mechanism, and particularly to a paper feeding mechanism that has a lifting plate to supply paper and is capable of automatically compensating feeding force for paper input.

#### **2. Description of the prior art**

In general, printers, copiers, FAX machines, or Multi-Function Peripherals (MFPs)  
10 have a paper conveying mechanism that consists of two rubber rollers of a greater friction coefficient. One is the pickup roller and the other is the feed roller. The top sheet of paper is first separated by the pickup roller, and then is transported by the feed roller to a printing module for printing.

For the machine models that have a lifting plate to hold paper, the paper feeding  
15 structure 100 is largely like the one shown in FIGS. 1 and 2. The lifting plate 120 has one end anchored on a base dock 140 and another movable end for holding paper 150. Since the pickup roller 110 is stationary, the paper 150 must be raised by the lifting plate 120 to be in contact with the pickup roller 110 and be picked up. The lifting plate 120 has a bottom side coupled with a spring 130, which provides a normal force  
20 required for paper pickup. Such a structure tends to generate a slight error when the spring fatigues after it has been used for a long period. Moreover, a constant paper pickup force is provided regardless of the amount or type of paper. It has drawbacks such as that the constant paper pickup force is applicable to only a specific type of paper. As different paper has different properties such as weight, density or stiffness, multi-

feeds or miss-feeds frequently occur. As a result, the paper suitable for feeding and printing is restricted.

To remedy this problem, the pickup roller must be able to automatically adjust pickup force according to the properties of paper, i.e. an automatic compensating capability.

5 One common approach is to dispose the pickup roller at a distal end of a swing arm. For instance, LEXMARK Co. of the U.S.A, has disclosed U.S. Patent No. 5,527,026, which has a drive roller (13) pivotally engaged on a bottom gear of a gear train (1). The drive gear (3) at the front end of the gear train is stationary. The entire gear train (1) and the drive roller (13) are movable depending on the amount of paper. The drive roller (13) is  
10 in contact with the surface of the top sheet. When all the gears in the gear train (1) rotate to drive the drive roller (13), a torque is generated to enable the drive roller to apply a normal force to the top sheet. The normal force is altered according to the characteristics of the paper, thus it can automatically compensate the pickup force to avoid the problems of multi-feeds or failed feeds.

15 However, for the models that employ the lifting plate, the pickup roller usually is stationary. With the pickup roller in a stationary condition, it cannot automatically adjust the pickup force.

## SUMMARY OF THE INVENTION

20 The primary object of the invention is to resolve the aforesaid disadvantages occurring with the conventional paper feeding mechanisms that employ the lifting plate, have a fixed pickup roller, and cannot provide automatic control for the pickup force, resulting in multi-feeds or miss-feeds.

The invention provides a paper feeding mechanism that mainly includes a swing gear

assembly, a lifting plate and a cam. The swing gear assembly includes a plurality of gears and a linkage bar. One end of the swing gear assembly is fixed and the other end is swingable to transmit rotational driving power from a driving power source. The lifting plate is for holding paper and has one fixed end and another movable end. The 5 cam is engaged with the swingable end of the swing gear assembly, and may rotate to drive the movable end of the lifting plate upwards or downwards to change the relative distance between the holding paper and the pickup roller and the contact force.

The invention, by coupling the swing gear assembly and the cam, aims at achieving such effects as enabling the lifting plate to automatically control the pickup force and 10 overcoming the problem of multi-feeds or miss-feeds resulting from different paper properties.

The foregoing, as well as additional objects, features and advantages of the invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

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#### **BRIEF DESCRIPTION OF THE DRAWINGS**

FIGS. 1 and 2 are schematic views of the prior art, showing the structure and an operating condition.

FIGS. 3 and 4 are schematic views of a first embodiment of the invention, showing 20 the structure and an operating condition.

FIGS. 5 and 6 are schematic views of a second embodiment of the invention, showing the structure and an operating condition.

FIGS. 7 and 8 are schematic views of a third embodiment of the invention, showing the structure and an operating condition.

FIG. 9 is a schematic view of the structure of a fourth embodiment of the invention.

## **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

The invention is adopted for use on paper conveying mechanisms in copiers, printers,  
5 FAX machines or MFPs. Only the features related to the invention will be elaborated in  
the following embodiments. Those functions and techniques known in the art will be  
omitted.

Refer to FIGS. 3 and 4 for a first preferred embodiment of the invention. The paper  
feeding mechanism 200 of the invention is located on a base dock 300. It mainly  
10 includes a swing gear assembly 210, a lifting plate 220, an arm 230, and a cam 240.  
Details of the structural and operational relationship of the elements will be elaborated  
as follows.

The swing gear assembly 210 includes a first gear 211, a second gear 212, and a  
linkage bar 213. The axle of the first gear 211 is fixed. The axle of the second gear 212  
15 is connected to the axle of the first gear 211 through the linkage bar 213 so that when  
the first gear 211 rotates the second gear 212 simultaneously rotates and swings. The  
swing gear assembly 210 transmits a rotational driving power from a driving power  
source (not shown in the drawings). As discussed in the description of the prior art, the  
structure of the gear train in such a swing arm structure can automatically control the  
20 rotational driving power. In addition, aside from the structure of the two gears and one  
linkage bar of the invention, the swing gear assembly may include more gears and  
linkage bars. The structure is also more flexible. Basically, as long as the gear assembly  
has one fixed end and another swingable end, the function may be achieved as desired.

The lifting plate 220 is for holding paper 250. It has one end anchored on a base dock

300 and another movable end. An arm 230 is provided that has one end coupled with a spring 231 and another end coupled on a fixed pivot shaft 232, and is capable of turning on the pivot shaft 232. The spring 231 may be an equivalent elastic member such as an elastic string.

5      The cam 240 is located below the arm 230 and has one side coupled on the same shaft with a gear 241.

Referring to FIG. 3, with the paper feeding mechanism 200 thus constructed, when picking paper the swing gear assembly 210 receives driving power from a driving power source (not shown in the drawing), the first gear 211 rotates clockwise, and the 10 second gear 212 is driven to rotate counterclockwise. Meanwhile, there is a friction force between the rotating first gear 211 and the linkage bar 213. As a result, the linkage bar 213 is swung clockwise to move the second gear 212 towards the gear 241 adjacent to the cam 240. Referring to FIG. 4, when the second gear 212 is in contact with the gear 241 and engaged thereof, the gear 241 and the cam 240 are driven to rotate 15 clockwise. The arm 230 is pushed by the cam 240 to swing upwards. Next, the spring 231 lifts the lifting plate 220 and the paper 250 to make contact with the pickup roller 400 and allow the paper to be picked up. In the mean time, the paper pickup force gradually increases because of the swingable swing gear assembly 210 until the top sheet of the paper 250 starts to move. The force varies according to the properties of the 20 paper such as weight, density or stiffness. Thus, automatic control for the pickup force is generated according to the properties of paper, and multi-feeds or failed feeds may be avoided. Compared with the prior art that employs the lifting plate and fixed pickup roller, the invention overcomes the problem of picking up paper with a single force.

After the paper has been picked up, the entire mechanism may be operated in reverse 25 to enable various elements to return to their original positions.

While the embodiment set forth above has the swing gear assembly 210 driving the cam 240 through the gear 241, in practice, the peripheral side of the cam 240 may have gear teeth formed thereon so that the gear-tooth on the cam 240 may be directly driven. Moreover, the elastic element is not mandatory for the automatic compensation of the pickup force. As long as the arm 230 can be directly linked to the lifting plate 220, adjusting the position or size of the cam 240 can achieve the function equally well.

In addition, aside from lifting or lowering the lifting plate by the cam through the arm, in practice, a direct transmission may also be used. More embodiments of the invention are depicted as follows.

Refer to FIGS. 5 and 6 for a second embodiment of the invention. The main difference from the first embodiment is that the arm and the spring are dispensed with. A cam 510 is located below the lifting plate 520. When the swing gear assembly 530 is activated, the first gear 531 drives the second gear 532 to rotate counterclockwise. Meanwhile, the linkage bar 533 is swung towards the cam 510. After the second gear 532 is engaged with the cam 510, the cam 510 is driven to rotate clockwise and push the lifting plate 520 and paper 540 upwards to be picked up by the pickup roller 550.

Since moving the cam below the lifting plate forms a crowded space, the lifting plate may be adjusted. FIGS. 7 and 8 illustrate a third embodiment for this purpose. The main difference from the second embodiment is that the lifting plate 620 has one side extended to form a straddle section 621, and the cam 610 is located below the straddle section 621. When the cam 610 rotates, it pushes the straddle section 621 to move the lifting plate 620. Such a design does not take too much space.

Moreover, if keeping the elastic element is desirable, it can be accomplished as a fourth embodiment as shown in FIG. 9. The elastic element 730 may be located between the cam 710 and the lifting plate 720.

In short, the invention employs a swingable swing gear assembly to couple with a lifting plate driven by a cam to control paper pickup force in the paper conveying mechanism that uses the lifting plate and fixed pickup roller, and to overcome the multi-feeds or miss-feeds problem.

5      Of course, the invention also is applicable to the pickup roller that is not fixed.

Furthermore, having means for driving the lifting plate via a cam is one of the features for the invention, but not limited by the structures disclosed in the preferred embodiments. Thus, any driving means that turns the cam to lift or lower the movable end of the lifting plate, to change the relative distance and a contact force between the  
10     paper and the pickup roller, shall be covered by the claims.

While the preferred embodiments of the invention have been set forth for the purpose of disclosure, modifications of the disclosed embodiments of the invention as well as other embodiments thereof may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments, which do not depart from the  
15     spirit and scope of the invention.